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1993-1998

U.S. Information Services
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JUNE 1993

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INFORMATION SERVICES OPPORTUNITIES IN CROSS-INDUSTRY MARKETS

1993-1998

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Introduction

A
Purpose

The purpose of this forecast report is to identify key changes in the market for information services in the engineering and scientific cross-industry market, and to provide the 1993 INPUT forecast for this market sector.

Sector Definition - INPUT defines cross-industry information services as packaged functional applications solutions that are not industry-specific—that is, they are used by multiple industry sectors. For example, accounting and planning and analysis are functions that are similar enough across all industries to be considered markets in their own right for non-vertical applications solutions. The seven cross-industry sectors defined by INPUT are:

- Accounting
- Human Resources
- Education and Training
- Engineering and Scientific
- Office Systems
- Planning and Analysis
- Sales and Marketing

The engineering and scientific cross-industry sector encompasses the following applications:

- Computer-aided design and engineering (CAD and CAE)
- Structural analysis
- Statistics/mathematics/operations research
- Geographic information systems/Mapping

CAD and CAE - Only non-industry-specific CAD and CAE activities are considered in this report. Computer-aided manufacturing (CAM) or CAD that is integrated with CAM is excluded from this report, since it is specific to the manufacturing industries. CAD or CAE that is dedicated to integrated circuit design is also excluded because it is specific to the electronics industry.

Structural Analysis - Structural analysis or finite element analysis helps engineers in a number of industries analyze the structural integrity and thermal adequacies of components. A relatively new and developing market is electromagnetic field analysis, which analyzes the interaction between electrical fields. Examples of applications are:

- Fuselage and wing internal load analysis (Aerospace)
- Bumper impact analysis (Automotive)
- Dynamic and static load analysis (Construction)
- Gearbox and transfer case stress analysis (Industrial machinery and mechanical design)

Statistics/Mathematics/Operations Research - Statistical and mathematical analysis applications encompasses all forms of sample and survey analysis for market research and product testing, including such diverse applications as personnel evaluation, decision support, health care analysis, computer performance evaluation, and operations research. Specific examples include:

- Reviewing/analyzing data from accident reports (Insurance)
- Evaluating air traffic controller information (Transportation)
- Census data collection (Federal Government and others)
- Monitoring of student performance, class selection, and education testing (Education)

GIS and Mapping - Geographic information systems (GISs) and desktop mapping are finding a broad range of applications. GISs and mapping software capture, manage, analyze, and display geographic information. Traditional uses include environmental monitoring, site planning, and natural resource management. Utility and transportation firms are using GISs for facilities planning and management tasks, and government agencies are using GISs to manage public resources. Examples of commercial applications include demographic market analysis to help retailers decide where to locate new stores, tax assessment programs for municipalities, and emergency vehicle routing for rapid response to critical situations.

The area of desktop mapping is a recent development, brought about not only by the proliferation of computer power at the desktop, but also by the increasing availability of geographic data bases and the ability to add street maps.

B
Organization

The balance of this report is organized as follows:

- Chapter II, *Trends, Events, and Issues*, discusses changes, market issues and activities, and competitive factors in the engineering and scientific sector that can have an impact on the current and future use of information services.
- Chapter III, *Information Services Market Forecast*, presents an analysis of the information services expenditures, by delivery mode and submode, for the U.S. engineering and scientific market.
- Appendix A, which contains the *Forecast Data Base*, presents a detailed forecast, by information services delivery mode and submode, for the engineering and scientific cross-industry market. A reconciliation to the previous forecast is also provided.

C
Methodology

Ongoing Research - Much of the data on which this report is based has been gathered during 1992 and early 1993 as part of INPUT's ongoing market analysis program. Trends, market sizes, and growth rates are based upon INPUT research and in-depth interviews with users in the engineering and scientific market sector and the IS vendors serving that sector. INPUT maintains ongoing relationships with, and a data base of, all users and vendors that it interviews. Interviewees for the research portion of this report were selected from this data base of contacts.

Resources - Extensive use was made of INPUT's corporate library located in Mountain View, California. The resources in this library include on-line periodical data bases, subscriptions to a broad range of computer, technical, scientific, and general business periodicals, continually updated files on over 3,000 information services vendors, and the most up-to-date U.S. Department of Commerce publications on industry statistics.

Forecast Estimates - Vendors, when responding to interviewers or questionnaires, may be unwilling to provide detailed revenue breakouts by delivery mode or industry. Also, vendors often use different categories of industries and industry segments, or view their services as falling into different delivery modes from those used by INPUT. Thus, INPUT must estimate revenues for these categories on a best-effort basis. For this reason, the delivery mode and individual segment forecasts should be viewed as indicators of general patterns and trends rather than specific, detailed estimates for individual years.

Rounding - When displaying market forecast values in bar and column charts, INPUT rounds these amounts for ease of visual reference. Markets of $1 billion or more are rounded to the nearest $50 million; $100 million to $999 million to the nearest $10 million; and $50 to $99 million to the nearest $5 million. Actual values are shown in charts for markets of $49 million or less, in Appendix A tables, and in chapter text.

D
Related Reports

In addition to this market-specific report, the reader may also be interested in related INPUT reports which address other cross-industry markets, specific delivery mode markets, and the U.S. and Worldwide markets for information services. Such reports would include the following INPUT publications:

- *Information Services Opportunities in Cross-Industry Markets, 1992-1997*
- *U.S. Processing Services Market, 1992-1997*
- *U.S. Professional Services Market, 1992-1997*
- *U.S. Network Services Market, 1992-1997*
- *U.S. Applications Software/Turnkey Systems Market, 1992-1997*
- *U.S. Systems Integration and Outsourcing Markets, 1992-1997*
- *Worldwide Information Services Forecast, 1992-1997*

Trends, Events, and Issues

A
Background

The engineering and scientific cross-industry market, as defined by INPUT, consists of four applications areas: computer-aided design (CAD) and engineering (CAE); structural analysis; statistics, mathematics, and operations research; and geographic information systems (GIS) and mapping.

Traditionally, engineering and scientific programs of any size and complexity have demanded larger processors—usually mainframes. These engines have typically been used for the complex designs or scientific analyses required by larger businesses that have both the need to perform complex designs and analyses and the means to pay for the resources required. The advent of powerful PCs, however, has placed effective scientific and engineering tools in the hands of virtually anyone with a need for such resources. Complex, sophisticated design and scientific analysis activity is still performed on mainframes and minicomputers, but smaller, more contained tasks have been steadily migrating to PCs. With the advent of even higher levels of processing power available from new engines such as Intel's Pentium chip, more and more engineering and scientific applications will be offered for PC- or workstation-based platforms.

Simply stated, the engineering and scientific operating environment is changing. More tools and products are PC-based, have PC options available, or can be used in a client/server environment. As a result, engineering and scientific activity, as a functional cross-industry capability, is becoming a cost-effective resource available to users at more and lower levels of business activity.

This chapter examines the trends, events, and issues that are driving the engineering and scientific marketplace.

B
Trends and Events

1. General Trends and Events

a. Platforms

The growth in the population of workstation/PCs in the business environment has been almost ballistic. Much of this growth is the result of the plummeting prices for PCs which, in turn, has resulted from a continuing drop in processor chip prices. *Computer Intelligence* noted that the price of desktop computers using 486DX chips had dropped from an average of $4,200 in October 1991, to about $2,000 in August of 1992—a period of only 10 months. This 50% drop in the cost of PCs with the power to drive most planning applications has made effective engineering and scientific tools available to almost any end-user.

The availability of such an effective, low-cost resource has also had an inevitable effect on the growth of other platform alternatives. Mainframe population growth is expected to continue, but at a rate significantly below that of PC/workstations. The growth of minicomputers (generally IBM AS/400s) as platforms for engineering and scientific applications has been relatively stable, and INPUT expects the population of such platforms to be essentially flat (no growth) over the next five years.

b. Downsizing and Decentralization

Re-engineering, outsourcing, downsizing, and decentralizing—these are the shorthand terms for change in the 1990s. As U.S. businesses emerge from the recent prolonged economic slowdown, many are re-assessing their resources, markets, products, goals, objectives, and ways of doing business. In many cases, businesses are re-engineering not only the way they do business (*not* a scientific and engineering activity), but also the products they produce. Firms of all sizes are positioning themselves and their products to take advantage of the emerging global marketplace, a shifting competitive environment, and to make better use of the many new technological tools available to them.

Downsizing and decentralization are also causing more and more companies to push engineering and scientific computing resources, and the responsibility for contracting for information services, further down in the organization—in some cases directly to the scientist or engineer end-user. The end-users, in turn, look for cost-effective, reliable, supported, scalable applications that can be easily installed and easily maintained. In many cases, their first consideration is shrink-wrapped PC applications software.

c. GUIs

The growing popularity and population of graphic user interfaces (GUIs), such as Microsoft's *Windows*, are improving both the quality and ease of use of PC-based engineering and scientific applications. High-resolution CRTs, icons, and easy-to-use graphics packages facilitate the design and analysis process and improve the quality of the end product. After using a GUI-based product, it is difficult to imagine how some applications—such as mapping, geographic information systems, and CAD—could be performed effectively in a non-GUI environment.

d. Networks

LANs, WANs, and MANs (Metropolitan-Area Networks) are becoming an integral part of the corporate communications environment and, thus, are becoming increasingly available to users for engineering and scientific activities. Networks are useful for gathering data from distributed sources; they are also the information conduit between clients and servers in a client/server environment.

e. Client/Server

Considering client/server architecture and invoking client/server applications is a hot technology topic for most U.S. businesses. Recent surveys of both U.S. and European businesses showed that client-server technology was regarded as an important emerging technology by almost half the respondents. No other technology identified even approached that level of interest, or that confirmation of value. It is clear that client/server architecture is here to stay, and that many engineering and scientific applications will be candidates for this production environment.

2. Technology Trends

There are a number of key technologies, both established and emerging, that will influence the cross-industry engineering and scientific marketplace during the forecast period. Although these technologies were embedded in the context of the general trends discussed in section B.1., they are summarized here because of their applicability to engineering and scientific processing activities. These technologies are:

PC/Workstations - The proliferation of these desktop resources will place efficient, high-performance engines for engineering and scientific applications at the lowest levels of design and analysis activity. Of specific interest is the processing capability of chips such as Intel's successor to the 486, the Pentium processor, which *PC Computing* magazine evaluated in its May 1993 edition. The article noted that Pentium's 64-bit external data path, doubling of hardware instruction pipelines and caches, write-back cache, and floating point speeds up to ten times faster than a 486 all

herald a new era in desktop power. One estimate of the Pentium's power noted that 16 Pentium processors using a fast bus would outperform an ES/9000.

Matching this growth in microcomputer platforms is the increasing availability of sophisticated, low-cost, pre-packaged applications software for these platforms.

One concern that traditional suppliers of non-PC (even non-workstation) platforms have is that the growing power accessible at the desktop will only be available from suppliers of established PC platforms using popular components such as Intel's processors. Nonstandard components and technologies, though powerful and useful, will not have the same market opportunity as an Intel-based PC running Windows and NetWare. These concerns have some validity when one considers the relatively small population of RISC systems, the recent exit of Next from the hardware market, and the fact that many excellent but non-PC servers have not had a significant penetration in this market. The exception to the PC-dominance hypothesis is Apple's Macintosh, and it has not positioned itself as a platform for the engineering and scientific marketplace.

Client/Server - This architecture is growing in popularity and is well-matched to the needs of the new, decentralized business environment.

Graphic User Interface - The GUIs are revolutionizing both user applications interfaces and the ease with which reports and charts are produced. Since so much of the engineering and scientific process is driven by a visual analysis or representation of calculated results, the increased availability of GUI-based applications will have a strong positive impact on this cross-industry market.

Networks - The use of networks tailored to the needs of the enterprise is facilitating the movement of information within a company's infrastructure. This ease of exchange, in turn, is helping the design, planning, and research processes by making more current information easily available to scientists, engineers, researchers, and other technical staff.

3. Applications Trends

This section examines significant trends in the areas of CAD and CAE; structural analysis; statistics, mathematics, and operations research; and geographic information systems (GIS) and mapping.

a. CAD and CAE

Traditionally, most cpu-intensive CAD/CAE work has been done on UNIX workstations with 64-bit paths, on minicomputers, or on mainframes. Intel's Pentium processor, with its 64-bit architecture, and less expensive workstations with more power, offer a new, cost-effective

resource for CAD/CAE applications. These new platforms can effectively run many computer-aided design and computer-aided engineering software tools. An inevitable result of this availability of power will be the migration of more processing resources closer to the end user. This, in turn, will stimulate a related migration to the workstation/PC environment of many applications which previously only were available on mainframes or minicomputers. By moving more CAD/CAE applications to workstation/PCs, smaller users who could not afford or justify the cost of the more expensive mainframe or minicomputer versions of these products will now have access to them on the smaller platforms.

Concurrent engineering, which allows a number of engineers to work concurrently on multiple phases of a product's design and engineering, will become more common as the more powerful workstation/PCs proliferate. By taking advantage of the new micro-platform's 64-bit architecture, multiprocessing systems will be able to cost-effectively perform many CAE applications in tandem rather than as sequential tasks. The same iterative ability applies to CAD applications, where the growing power of workstation/PCs will allow more design iterations in less time, resulting in faster, better design prototypes.

Object database technology is another area that is adding functionality and performance to CAD/CAE applications. By removing functionality from the program and embedding it in the objects in an object-oriented data base management systems (ODBMS), the code which must be resident in the application can be reduced by as much as a factor of five. This, in turn, allows for better program performance and more and faster design iterations. Two of the most significant benefits of object technology for CAD/CAE applications are the ability to deal with complex data types not easily manipulated with existing technology and more accurate modeling of a problem domain.

Other technologies that will expand the scope of CAD/CAE applications are the new families of printers which offer improved shading and color accuracy for applications where such precision is needed to communicate necessary information. New printer technologies include thermal wax printers, which use a series of overlapping dots to shade colors, and new phase change inkjet printers which can print intense colors on ordinary paper. The thermal wax process is most useful where color images must convey precise information based upon shading, as for scientific imaging. Phase change ink-jet technology can be used for preprinted design and engineering forms.

Windows NT is an operating environment that is attracting attention in many application areas, including CAD/CAE, where low-cost, 32-bit technology can meet application needs. This environment includes PCs using Intel's 386 and 486 chips and the RISC-based DEC Alpha and MIPS R4000 systems. *Windows NT* is expected to be as powerful as UNIX, but with the ease of operability that users have come to expect from *Windows*.

Although technology has allowed the migration of sophisticated CAD/CAE applications to smaller workstation/PC platforms, costs still remain significant. Prices for generic CAD/CAE workstation/PC software packages run from as little as $900 to more than $16,000.

Significant CAD/CAE application trends are summarized in Exhibit II-1.

EXHIBIT II-1

CAD/CAE Applications Trends

- PC-based software options
- Concurrent engineering
- Use of object-oriented data bases
- Use of more sophisticated printers for color output

b. Structural Analysis

As with CAD/CAE, structural analysis applications are benefitting from the advent of more powerful workstation/PCs in the workplace. Although 32-bit processors have been capable of handling many structural analysis applications, analyses of greater complexity or with larger data arrays will perform much better in a 64-bit environment. Many structural analysis applications using graphical representation, with complex information handling, retrieval, recognition, and interpretation capabilities that once required the 64-bit power of a supercomputer, will now be able to be processed on a 64-bit microcomputer.

Most 32-bit systems can only access files of four gigabytes or less. For most commercial applications, this is not a significant limitation. For scientific and engineering applications like CAD, CAE, and structural analysis, it has forced the user to the greater expense of a 64-bit mainframe. Now, with 64-bit workstations and PCs, a viable, cost-effective alternative exists, and INPUT expects to see more and more sophisticated structural analysis applications offer micro-based alternatives.

As an example of the downsizing of the structural analysis processing environment, DEC has recently introduced its 64-bit Alpha AXP, a RISC system aimed at users with heavy computational requirements such as CAD, CAE, and structural analysis applications. The AXP can function as a desktop unit or as a server. IBM's RS/6000, which can also act as a server to multiple clients, is used as a structural analysis platform, and one was installed for that purpose at a NASA site to perform structural and turbine blade analysis. The Lawrence Berkeley Laboratory (LBL) uses

HP9000s and HP ME30 software for high-end 3D applications. LBL also uses Rasna Corporation's Applied Structure release 3.0, a 3-D structural analysis program that allows designers to perform a broad variety of tasks on-line.

Before 32-bit technology is discarded in favor of 64-bit technology, however, some manufacturers, such as MasPar, have pushed 32-bit technology to new boundaries. MasPar's MP-2 supercomputer, a massively parallel (MP) machine, uses 32-bit SIMD (single instruction, multiple data) processors to perform such compute-intensive applications as fluid dynamics and structural analysis. The MP-2's architecture favors applications such as structural analysis that have identical computations for very large data sets, where there is interaction only between nearest neighbors in the data set.

c. Statistics/Mathematics/Operations Research

No matter what the industry or product, statistical analysis, mathematical routines, and operations research (OR) techniques and evaluation will be useful tools and will generally function without industry- or product-unique modifications. As with CAD, CAE, and structural analysis, the availability of powerful, new workstation/PC platforms provides the opportunity to migrate many of the more sophisticated mathematical analyses from larger minicomputers and mainframes to smaller platforms in the hands of the end user. In many cases, mainframe application architecture and design doesn't have to change dramatically (if at all), since the smaller platforms have memory size and processor speeds equivalent to that of many mainframes.

An unusual (but significant) trend in the use of mathematical, statistical, and OR routines and techniques is the need to communicate the results of the analysis to mathematically unsophisticated managers, analysts, or others who will make use of the computational or analytical results. Some researchers have even gone so far as to determine how to present such data based upon the audience's or recipient's decision-making style. OR analysts can help those with sensation-thinking, sensation-feeling, intuition-feeling, or intuition-thinking decision-making styles by presenting data in ways that are acceptable to a specific style. This not only allows the audience to more easily understand and relate to the analysis and results, it also packages the data in ways most immediately useful the client. Essentially, what occurs is that the OR staff integrates communications theory, cognitive style, and computer simulation to produce results that are accurate, easily understood, and immediately implementable. Tools such as the GUIs, graphics, and presentation packages that are available with most applications facilitate this process.

d. Geographic Information Systems/Mapping

Mapping is no longer simple cartography. It's least-cost routing for shipments, trip planning for vacationers, territory planning for sales managers, property tax boundaries for municipalities, and demographic representation and analysis for governments at all levels—local, state and federal. Because of the size of the data bases typically used to analyze geographic data, most geographic information systems (GISs) have run on mainframes, and it is only with the proliferation of powerful PCs that such applications have been able to move to a smaller platform. Large government and commercial applications will almost certainly continue to use mainframes, while newer, more popular consumer and small business applications will use PCs.

The majority of new GIS applications are being written for microcomputers, and most offer map-related data bases and sophisticated information manipulation and display capabilities. Color is a key attribute for GIS and mapping visual displays, either as hard copy or on VDTs, and the continuing drop in VDT and color printer costs is helping to grow this market. (See section 3.a., above, for additional information on new types of color printers.)

GIS is useful for more than just mapping. Utility companies use GIS to maintain information for service areas, telecommunications firms manage data related to land-lines and wireless (cellular) on GIS, government agencies use it for environmental studies and long-range planning, and the commercial sector is developing many uses, including inventory management and demographic analysis. Digital Equipment Company alone offers more than 50 GIS systems, and its Alpha AXP workstation (see 3.b., above) is a platform which has performance characteristics well matched to GIS processing needs.

Emaps are a new GIS application area. They are tools which provide enhanced visualization of the interactions between various elements in environmental scenarios. In function, they are similar to standard CAD applications, but they differ in that they allow researchers to change the attributes of single cells, to be able to evaluate their interactions with neighboring cells, and eventually the entire representative landscape. Emaps resemble 3-D maps, but their use is dynamic rather than static.

Individual and departmental users can find powerful mapping and analysis tools available for their standard work environment at a nominal cost. MapLinx Corporation's MapLinx for Windows costs about $400, runs under Windows, and uses dBase and Act for Windows files. Maps can be viewed at 16 different levels, can include U.S. ZIP codes, 23,000 cities, and most major highways, and can be annotated by the user.

Representative sophisticated desktop mapping systems with prices from $395 to $5,995 include Environmental Systems Research Institute's Arc/Info 3.4D, GeoQuery Corporation's GeoQuery 3.0, MapInfo Corporation's MapInfo 2.0 for Windows, Strategic Mapping Inc.'s Atlas GIS 2.0, and Tactics International Ltd.'s Tactician 2.0. Tactics International's products use SQL and range in price from $2,495 to $9,995.

Marrying geographic information systems (GIS) to global positioning systems (GPS) will eventually let every business know where key assets are at any time, and every traveler know where *he* or *she* is at any time. The pieces are all in place. It's only a matter of time.

Exhibit II-2 highlights key GIS/Mapping applications trends.

EXHIBIT II-2

GIS/Mapping Applications Trends

- Applications moving to micros
- Offer map-related data bases
- Color is a key attribute
- Emaps a new application area
- Costs coming down
- More consumer-oriented products

C
Issues

The two major issues, from an information services viewpoint, are the suitability and cost-effectiveness of various platforms for engineering and scientific applications, and the viability of CAD and CAE as a cross-industry market. Both of these issues are discussed below.

1. The Cross-Industry CAD/CAE Market

Computer-aided design and computer-aided engineering products are used in virtually all manufacturing industries. As generic design and engineering tools become more accepted by, and hence more useful to, an industry such as aerospace or automotive or small electronics, there is a vendor tendency to refine them and either make them industry-specific or offer industry-specific versions of the original generic product. When this

occurs, the design or engineering tool is no longer a cross-industry resource; it is a useful, industry-specific design or engineering tool—and is now counted by INPUT as an applications software product used by the specific industry.

As new software design and engineering tools are developed, they will frequently be offered first in generic versions, then refined, based upon usage experience, to meet the specific needs of the largest industry markets. The effect of this product cycle is to limit the size of the generic cross-industry engineering and scientific tool market, since the most dynamic growth will occur via industry-specific product variations. Vendors are not overly concerned with this growth pattern, since they will sell products into both generic and industry-specific markets. The market size and growth numbers in Chapter III and Appendix A reflect this market pattern.

2. Platforms

There is no question about it—greater power is coming in smaller packages. The Intel 386 and 486 processors allowed many compute-intensive applications to migrate from mainframes and minicomputers to PCs, and powerful workstations—such as those offered by Sun Microsystems, Inc.—offered another migration path for scientific and engineering applications. Many scientific and engineering applications will continue to run on large mainframes and minicomputers for the foreseeable future. They either have processing requirements or data manipulation needs so massive that no other platforms are viable. In some cases, time (or job turnaround) limitations mandate the larger platform requirement.

Then along came Intel's Pentium, and the controversy over the need for mainframes and minicomputers is starting again. There is no question that some applications—due to the size of their code, their I/O requirements, or their need for access to large volumes of data—will remain on the larger platforms. But the availability of a microprocessor with up to ten times the speed of an i486, and the promise of even greater speeds in the future, is a clear indicator of the migration path that will be followed by more and more vendors as applications are placed closer to the end-user. Where application parameters permit, vendors can be expected to provide scaled-down versions of their large-system applications.

INPUT believes that most of the growth that will occur in the engineering and scientific cross-industry market will be driven by the availability of the smaller, more powerful workstation/PC platforms. These small, powerful platforms will offer end-users a new processing alternative designed to meet their personal analysis needs, and vendors will have a new market in which to sell existing or improved products. The net effect will be continued growth in this market, fueled by the growth in the use of workstations/PCs.

Information Services Market Forecast

A
Overview

INPUT defines cross-industry markets as being served by only the applications software, processing services, and turnkey systems delivery modes, since other delivery modes are only meaningful in an industry-specific context.

This chapter provides the U.S. forecast for the engineering and scientific cross-industry information services market sector. Total market and delivery mode forecasts are offered, and expenditures are presented by platform for applications software products.

Note that values shown in the graphic exhibits in this chapter have been rounded for ease of reference. Actual values may be used in the text and are indicated in Appendix A, the *Forecast Data Base*.

Market Attribute - One of the unique attributes of this market sector is that as many general purpose (or generic) applications or services are determined by scientists and engineers to be useful, these resources tend to become increasingly oriented towards one (or a number of) industry's needs, and eventually become industry-specific—thus removing such information services and their associated revenues from this cross-industry category. This phenomenon is most noticeable with engineering CAD and CAE applications. It is less of a factor with statistics, mathematical, and operations research applications, where units, groups, or populations are analyzed without regard for their nature or function.

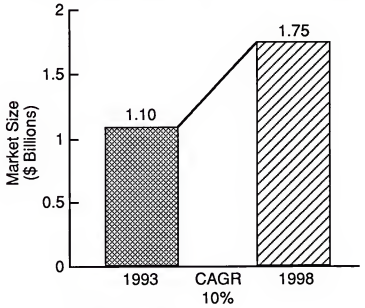
Impact of Workstation/PCs - As a result of the growing availability of low-cost, high-performance workstation/PC engines to drive applications, by 1998 almost half of this market's revenues will come from the PC/workstation applications software delivery submode.

B
Information Services Market

The size and compound annual growth rate (CAGR) of the engineering and scientific cross-industry information services market from 1993 to 1998 are noted in Exhibit III-1.

EXHIBIT III-1

Engineering and Scientific Cross-Industry Sector Information Services Market, 1993-1998



Values rounded.

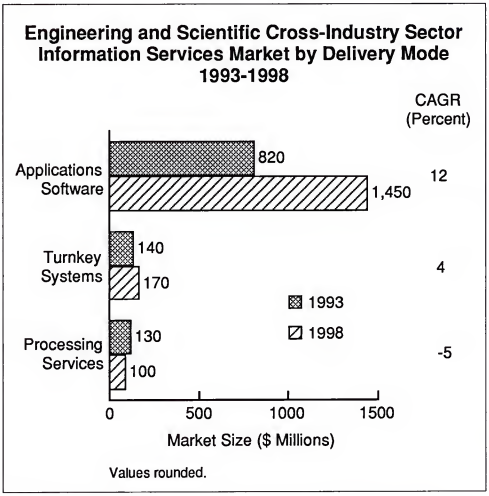
1993 revenues for this market totalled slightly less than $1.1 billion in 1993, and are expected to grow at a 10% compound annual rate to almost $1.75 billion in 1998. This moderate cross-industry growth is fueled by the strong growth in workstation/PC-driven applications software revenues.

Overall market growth for this sector will be 9% per year in 1993 and 1994, 10% in 1995 through 1997, and 11% in 1998. The modest increase in growth rate is driven by the growth in the workstation/PC population, which will take advantage of the power of both faster chips and local-bus systems.

C
Delivery Mode Analysis

Exhibit III-2 offers the engineering and scientific cross-industry sector market growth by delivery mode.

EXHIBIT III-2



1. Applications Software

Simply stated, the growth in sales of application software is the engine that is driving the engineering and scientific market sector. This market is forecast to grow at a compound annual rate of 12%, from slightly more than $800 million in 1993, to almost $1.5 billion in 1998. It reflects a continuing interest in engineering and scientific software as a viable analysis tool—a resource which is becoming significantly more cost-effective in the expanding workstation/PC computing environment.

Market size, by platform, is discussed in section D below.

2. Turnkey Systems

Although the majority of the turnkey systems (including VARs) in this industry are for computer-aided design (CAD) and engineering (CAE) applications, some mapping (GIS) turnkey solutions are also available. As with all other delivery modes in this cross-industry market sector, growth tends to be limited due to most businesses' tendency to require industry-specific functionality.

The original CAD vendors addressing this cross-industry market sector offered turnkey systems, providing what were, at the time, specialized engineering workstations and applications software solutions. The trend now is to not tie applications products to a single platform, and to offer both applications scalability and portability to meet a wide range of user needs, while minimizing requirements for changes in function or format. Limited turnkey system growth is still available from sales of such platforms to smaller companies or to departmental users within larger companies.

INPUT estimates the 1993 market for turnkey systems at almost $140 million, up 5% from 1992. Growth through 1998 is expected to decrease slightly, to a 4% five-year CAGR, resulting in a 1998 market of $170 million.

3. Processing Services

In pre-workstation/PC days, transaction processing services such as time-sharing or remote batch offered the scientist or engineer a computing resource that was more responsive to needs than many in-house data processing departments. In addition, costs were proportionate to use, response (job turnaround) was negotiable (for a fee), and the vendor frequently provided sophisticated applications software not easily accessed or obtained elsewhere.

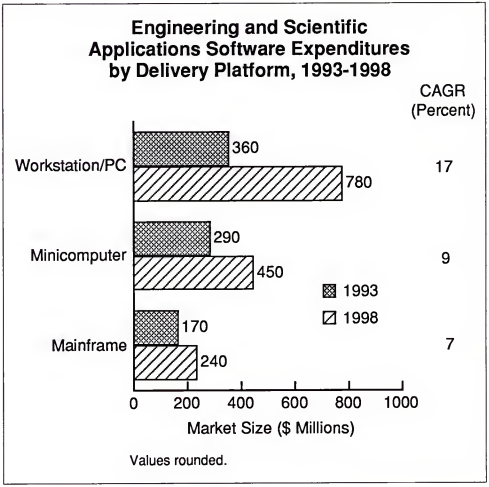
The global population of low-cost workstations and PCs, however, and the growing availability of engineering and scientific application software for these platforms, has had a dramatic effect on this delivery mode. Over the past few years, more and more users have offloaded their transaction processing applications to in-house micros, mainframes, or minicomputers. The advent of more client/server applications, coupling PC clients to larger platforms (servers) will continue this slow but steady migration.

INPUT estimates the 1993 market for transaction services at $130 million, down 1% from $131 in 1992. Annual revenues are forecast to decrease further to $100 million by 1998, at a compound annual rate of -5%.

D
Platform Analysis

Exhibit III-3 summarizes 1993 applications software revenues by delivery platform.

EXHIBIT III-3



Workstation/PCs - As noted earlier, the engineering and scientific market is essentially driven by the growth in sales of applications software to workstation/PCs. In 1993, expenditures for applications software using this platform are forecast to be almost $360 million, a 15% growth over 1992. As U.S. businesses recover from the recent prolonged recession, INPUT forecasts that the workstation/PC applications software products growth from 1993 to 1998 will be at a CAGR of 17%, due to the steadily growing population of powerful, cost-effective, sophisticated workstation/PCs and workstation/PC-based applications for engineering and scientific activities. By 1998, engineering and scientific software product revenues for this platform will be $780 million.

Minicomputers - INPUT estimates 1993 revenues for minicomputer-based applications software at $290 million, a 9% growth from 1992. Part of this increase is a residual growth resulting from the unsatisfied requirements occurring during the recent economic slowdown. Engineering software has had a strong mid-sized platform orientation, and although there will be some migration to workstation/PCs, new installations of powerful minicomputer-based products by both mid-sized and smaller companies are expected to continue the growth of software products for this platform at a 9% CAGR for the period 1993-1998. INPUT estimates the minicomputer-based market at almost $450 million by 1998.

Mainframes - Mainframes, contrary to many opinions, are not a dying breed. For many large engineering or scientific applications they are the only logical platform, and in a client/server environment they have both the resources and connectivity to function as an ideal enterprise-wide server. INPUT forecasts that 1993 applications software revenues for this platform will be slightly more than $170 million, an 8% growth over 1992 figures, and believes that there will be a continuing growth of complex engineering and scientific activities best suited to a mainframe platform.

There is a strong motivation for U.S. businesses, in the highly competitive global market, to improve design sophistication, product functionality, and work-force productivity—and thus company sales and profitability. Many of these attributes are the end-results of engineering and scientific activities—many of which use and will continue to use mainframe-based applications resources. As a result of this analysis, INPUT forecasts the 1998 mainframe-based market at $240 million—the result of a slightly reduced (7%) five-year (1993-1998) compound annual growth rate. This reduced growth is a direct result of the growing impact of more powerful workstations and PCs, and also considers the role of mainframes as servers in a client/server environment.

Forecast Data Base

This appendix contains the forecast data base for the period 1993-1998 and the 1993 MAP data base reconciliation.

A

Forecast Data Base

Exhibit A-1 presents the detailed 1992 actual and 1993-1998 forecast for the engineering and scientific cross-industry market sector.

EXHIBIT A-1

Engineering and Scientific Cross-Industry Sector Market Size Forecast by Delivery Mode, 1992-1998 ($ Millions)

Delivery Modes	1992 ($M)	Growth 92-93 (%)	1993 ($M)	1994 ($M)	1995 ($M)	1996 ($M)	1997 ($M)	1998 ($M)	CAGR 93-98 (%)
Sector Total	996	9	1,084	1,178	1,294	1,417	1,565	1,735	10
Processing Services	131	-1	130	123	116	110	105	100	-5
- Transaction Processing	131	-1	130	123	116	110	105	100	-5
Turnkey Systems	130	5	137	145	153	160	166	170	4
Applications Software	735	11	817	910	1,025	1,147	1,294	1,465	12
- Mainframe	160	8	172	185	200	212	224	240	7
- Minicomputer	265	9	290	315	345	375	410	445	9
- Workstation/PC	310	15	355	410	480	560	660	780	17

B
Forecast Reconciliation

Exhibit A-2 offers a reconciliation of the 1992 and 1993 forecasts for the engineering and scientific cross-industry sector.

EXHIBIT A-2

Engineering and Scientific Cross-Industry Sector
1993 MAP Data Base Reconciliation
($ Millions)

Delivery Modes	1992 Market				1997 Market				92-97 CAGR per data 92 Rpt (%)	92-97 CAGR per data 93 Rpt (%)
	1992 Report (Fcst) ($M)	1993 Report (Actual) ($M)	Variance from 1992 Report ($M)	Variance from 1992 Report (%)	1992 Report (Fcst) ($M)	1993 Report (Fcst) ($M)	Variance from 1992 Report ($M)	Variance from 1992 Report (%)		
Total	986	996	10	1	1,530	1,565	35	2	9	9
Processing Services	130	131	1	1	100	105	5	5	-5	-4
Turnkey Systems	129	130	1	1	165	166	1	1	5	5
Applications Software	727	735	8	1	1,265	1,294	29	2	12	12

There were only minor differences of 1% or less between the 1992 projection for all categories of 1992 expenditures and the actual amounts noted in the 1993 report. The minor variances reflected the fundamental stability of this market on a year-to-year basis.

Variances in the market projections for 1997 were also small, and ran from $1 million to $35 million, or from 1% to 5%. The largest change, an increase of $29 million in the market for applications software, is the result of the stronger growth anticipated for the workstation/PC platforms. The 5% change for processing services results from a slight reduction of 1% (from -5% to -4%) in the rate at which this market is eroding.

The 1992-1997 compound annual growth rates (CAGR) show a 1% variation in only one area, processing services, as a result of the slight increase (noted above) in the performance of this market.

Index of Companies

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Many vendors leverage INPUT's proprietary data and industry knowledge by contracting for custom consulting projects to address questions about their specific market strategies, new product/service ideas, customer satisfaction levels, competitive positions and merger/acquisition options.

INPUT advises users on a variety of IT planning and implementation issues. Clients retain INPUT to assess the effectiveness of outsourcing their IT operations, assist in the vendor selection process and in contract negotiation/implementation. INPUT has also evaluated users' plans for systems and applications downsizing.

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PRODUCTION QC SCHEDULE

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Cover Title—Exactly how it is to appear on the report cover:
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Front: 1st Line ENGINEERING & SCIENTIFIC

2nd Line

3rd Line

Spine: (1 Line)

(Binder spine may have 2 lines)

Estimated number of pages: <100 ☒
100-150 ☐
150-200 ☐
>200 ☐

Executive Overviews:
No. required for Thank-You packages: Ø

Program Manager Approval: _____ Date: _____

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MCS

Dear Colleague:

Attached is the Information Services Market Analysis Program's latest cross-industry sector forecast update for the *Engineering and Scientific Market*. It provides a current assessment of the events and issues driving this marketplace, and offers INPUT's forecast of the market size for information services for the period 1993-1998.

This report should be filed with INPUT's other *U.S. Information Services Market Analysis Program* reports, behind the tab marked *Engineering and Scientific*. Your INPUT program binders, together with the delivery mode reports, provide a total assessment of the United States market for information services.

Market Analysis Program industry and cross-industry sector reports are prepared annually, and may be in one of two forms. The expanded report will contain a detailed industry analysis and supporting forecast data. It will typically be 40-50 pages in length. The forecast update will be a short report, providing a new forecast and summary data to support forecast assumptions. It will generally be 15-20 pages in length. Normally, for each industry and cross-industry market segment, full reports will be produced every other year, with summary reports prepared in the intervening years. The intent of this new format is to recognize the value of our clients' time, and provide concise statements of industry activity, supported by rigorous business, technical and competitive analysis, and a five-year industry forecast.

I am certain that you will find the cross-industry *Engineering and Scientific* report to be both informative and useful, and welcome any comments that you have on this document, or any of INPUT's publications.

Sincerely,

Robert L. Goodwin
Manager
Information Services
Market Analysis Program

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Manager, Information Services Market Analysis Program

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